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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
Robert James TRIBE	
Serial No.	Art Unit:
Filed: concurrently herewith	Examiner:
For: SYRINGE PUMPS	Atty Docket: 0100/0130

SUBMISSION OF PRIORITY DOCUMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Attached hereto please find a certified copy of applicant's patent application No. 0020058.4 filed in Great Britain on August 16, 2000. Applicant requests the benefit of said August 16, 2000 filing date for priority purposes pursuant to the provisions of 35 USC 119.

Respectfully submitted,

Louis Woo, Reg. No. 31,730
Law Offices of Louis Woo
1901 N. Fort Myer Drive, Suite 501
Arlington, Virginia 22209
Phone: (703) 522-8872

Date: Aug 3 2001

USA

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

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Signed Andrew Gersey

Dated 17 July 2001

Patents Form 1/77

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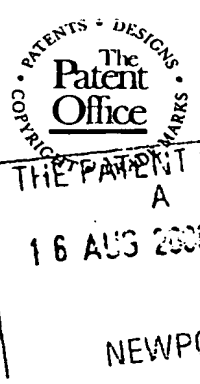

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

   00.PDOD

2. Patent application number
   (The Patent Office will fill in this part)

   0020058.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

   SMITHS INDUSTRIES PUBLIC LIMITED COMPANY
   765 FINCHLEY ROAD
   LONDON
   NW11 8DS

   Patents ADP number *(if you know it)*

   ~~728708002~~

   16AUG00 E560986-1 C03234
   P01/7700 0.00-0020058.4

   If the applicant is a corporate body, give the country/state of its incorporation

   GB 7257050002

4. Title of the invention

   SYRINGE PUMPS

5. Name of your agent *(if you have one)*

   J. M. FLINT

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   765 FINCHLEY ROAD
   LONDON
   NW11 8DS

   Patents ADP number *(if you know it)*

   1063288002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

   YES

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Description	5
Claim(s)	
Abstract	
Drawing(s)	2+2

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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature J Flint Date 15/08/00

12. Name and daytime telephone number of person to contact in the United Kingdom J.M.FLINT 020 8457 8220

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SYRINGE PUMPS

This invention relates to syringe pumps.

Syringe pumps are used to supply medication to a patient from a pre-filled syringe via an infusion line. The syringe pump applies a force to the plunger of the syringe to drive medication into the infusion line at a controlled rate. The head of the plunger is engaged by a plunger head actuator that is movable along a leadscrew extending parallel to the axis of the syringe. The head actuator is movable from an extreme position at one end of the pump, where it allows the largest syringe to be loaded into the pump with its plunger fully extended, to an extreme position at the opposite end of the pump, where it fully depresses the plunger of the smallest syringe. There is a risk, when the head actuator is being moved back to its loading position, that the head actuator may trap the user's finger or other objects between the actuator and the pump housing.

It is an object of the present invention to provide an alternative syringe pump and method of operation.

According to one aspect of the present invention there is provided a syringe pump adapted to receive a syringe of the kind having a plunger movable along a barrel, the pump including a plunger head actuator coupled with an electric motor and operable to move the plunger along the barrel, the pump being arranged to detect an obstruction to movement of the head actuator by monitoring change in speed of the motor.

The pump is preferably arranged to stop movement of the head actuator when an obstruction is detected. The change in motor speed is preferably detected by timing the interval between pulses produced at a frequency dependent on motor speed. The pulse output is preferably generated by a shaft encoder.

According to a second aspect of the present invention there is provided a method of detecting an obstruction to movement of a plunger head actuator by monitoring the speed of a motor driving the plunger head actuator and detecting when the speed falls such as to indicate an obstruction.

The method preferably includes the step of producing pulses at a frequency dependent on motor speed and timing the interval between pulses in order to detect when motor speed falls.

A syringe pump and its method of operation, according to the present invention, will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a simplified view of the front of the pump; and

Figure 2 is a graph illustrating the effect on motor speed of an obstruction to movement of the plunger head actuator.

The pump includes an outer housing 1 with a recess 2 on its front surface shaped to receive a syringe 3 of conventional kind. The syringe 3 has a cylindrical barrel 30 with an outlet or nose 31 at its forward end and a flange or ear 32 at its rear end. The nose 31 is connected to an infusion line 5 so that a medication liquid in the syringe 3 can be dispensed to a patient via the infusion line, by pushing in the plunger 35.

The pump has a drive mechanism 7, including a leadscrew 8 driven by an electric stepper motor 9. A plunger head actuator or retainer mechanism 10 engages the head 36 of the plunger 35 and is movable along the leadscrew 8 as it rotates, so as to move the plunger along the barrel 30. Further details of the plunger head actuator are given in GB0014483. The motor 9 is driven by a control unit 11, which receives inputs from a keypad 12, or other user input means, and various sensors (not shown). The control unit 11 also provides an output to a display panel 13. An optical sensor and encoder disc 20 attached with the leadscrew 8 provides an output to the control unit 11 for use in controlling the position and the speed of movement of the plunger head actuator 10. In addition, the control unit 11 uses the output from the encoder 20 to detect an obstruction to movement of the plunger head actuator 10 when the actuator is moved back towards its parked or loading position at the extreme right-hand side of the pump.

The plunger head actuator 10 is moved rearwardly to this loading position at a relatively fast speed. As illustrated in Figure 2, it can be seen that the angular velocity of the motor 9 (and hence the linear speed of the actuator 10) accelerates rapidly initially and then becomes relatively constant as it reaches its maximum speed. This speed continues until the actuator 10 reaches a position close to its end of travel when an end-of-travel sensor (not

shown) is tripped and power to the motor 9 is terminated. If, however, there is an obstruction to movement of the actuator 10, such as caused by a user's finger inadvertently placed in the recess 2 to the right of the actuator, the motor speed will drop, as indicated by the broken line in Figure 2. The control unit 11 rapidly detects this fall in motor speed and responds by stopping supply of power to the motor 9 and by providing an alarm output, such as an audible alarm from a buzzer (not shown) and a legend on the display panel 13. The control unit 11 could detect the fall in motor speed by continuously measuring the magnitude of deceleration of the motor 9 and responding if this exceeds a predetermined limit. However, a preferred arrangement has been found to be less complicated. In this, the control unit 11 includes a timer 21, which receives the output of the encoder 20 and measures the time elapsed between each step of the motor. Typically, the motor 9 makes 200 steps per revolution and the encoder disc 20 provides a resolution of 2000 steps per revolution, so the timer 21 times the intervals between groups of 10 steps of the encoder disc in order to measure the time between each motor step. The timer 21 may be a discrete unit, as shown, or the timing function may be carried out by programming of a processor in the control unit 11. The timer 21 stores in a memory 22 information as to the minimum time t_{min} so far between steps. As each time interval t is measured, a comparator 23 compares this with the minimum time t_{min} in the memory 22. If $t > n.t_{min}$, where $n = 8$, the control unit 11 determines that the head actuator 10 is obstructed and stops power supply to the motor 9. It will be appreciated that the sensitivity of detection could be altered by choosing a different value for n. A greater value of n would reduce sensitivity, whereas a smaller value of n would increase sensitivity.

The present invention enables an obstruction to movement of the plunger head actuator to be rapidly detected, thereby preventing injury and damage to the pump, without

the need for any additional sensors. It will be appreciated that the invention is not confined to the detection of an obstruction during rearward movement of the actuator while unloading but that it could also, or alternatively, detect an obstruction during forward movement of the actuator while loading.

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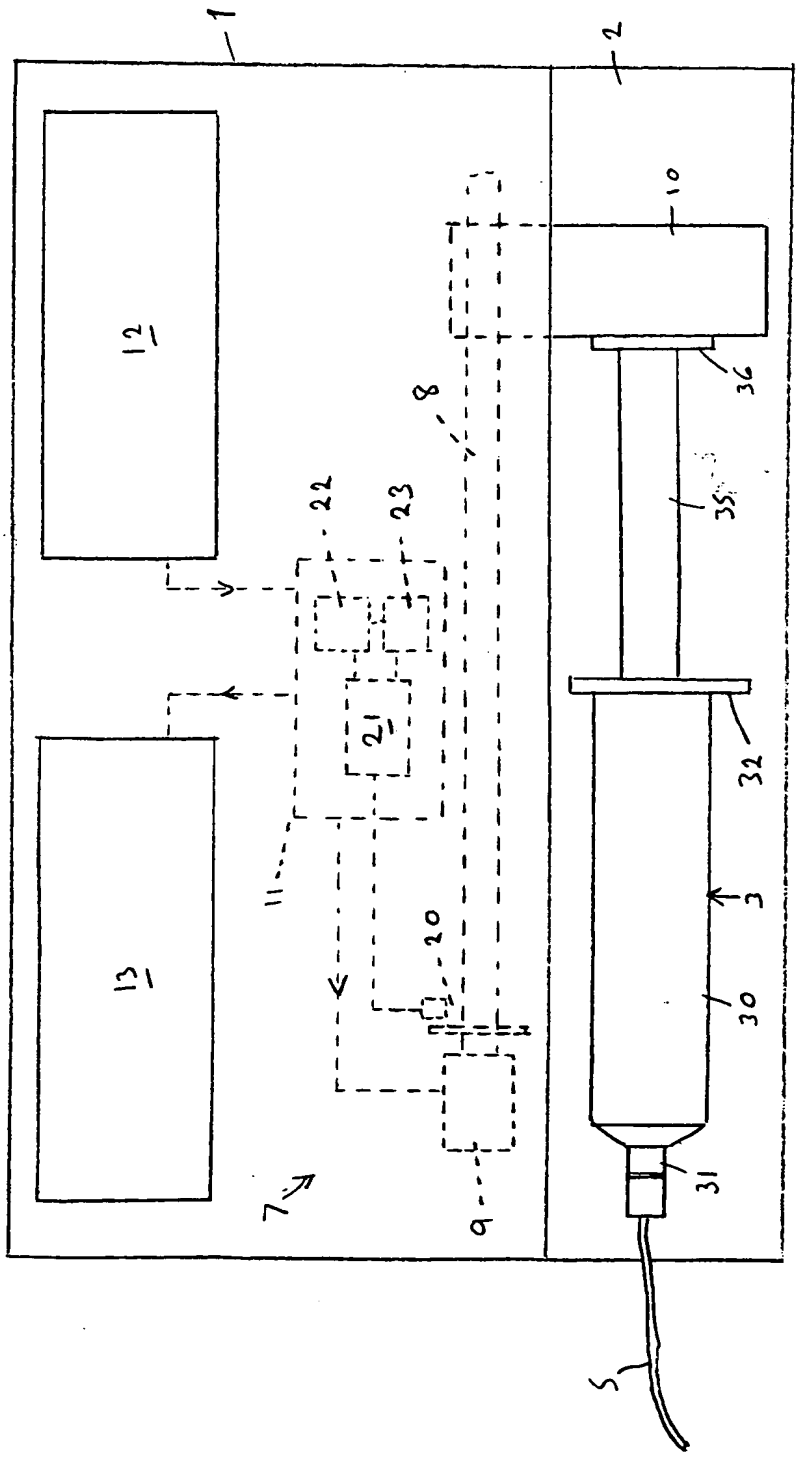

FIG. 1

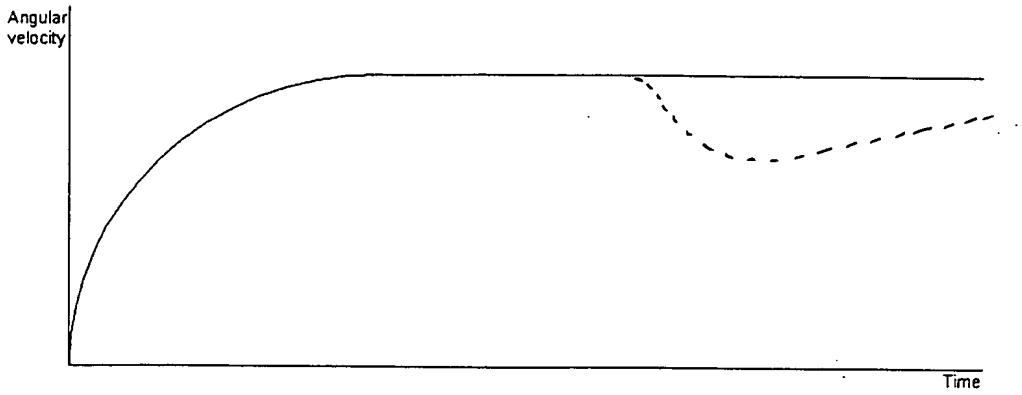

FIG. 2